CADD Standards Manual

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Utah Department of Transportation
Information System Services: Engineering Technology Systems

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Chapter 1 - Introduction

Purpose

The electronic files created during the process of developing a Computer Aided Design and Drafting (CADD) project for UDOT are to be shared and referenced by many different individuals and must satisfy various needs. The electronic files must be shareable in a format that most, if not all, parties can utilize. Therefore, CADD processes must be established for disciplines that share in the CADD development workflow. This CADD Standards Manual outlines the required standards, conventions and formats necessary to provide the most usable CADD data set to the foreseeable customers of the CADD data, while providing the producer/developer of the CADD data information necessary to accomplish the task.

Scope

This CADD Standards Manual sets forth supplemental guidelines to the Utah Department of Transportation CADD Manual (being developed). The material presented within this guideline will be monitored as a critical requirement under the CADD Quality Assurance plan. This document is written for CADD users producing plans and maps for UDOT. It provides the guidelines to produce electronic CADD files according to UDOT CADD standards in conjunction with UDOT CADD software.

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This manual documents graphic and operational standards that pertain to MicroStation and the general project file structure. This manual is designed to be used in conjuction with other CADD manuals that define civil data standards, integration of cadd in the design process, and cadd guidelines for UDOT consultants. Please refer to the Scope section of each of the following manuals for a more complete description: Civil Design CADD Standard Manual, Project Workflow for CADD, Consultant CADD Guidelines.

General

Title 72 of the Utah Statues, known as the Transportation Code, establishes the responsibilities of the State, Counties, and Municipalities for the planning and development of the transportation systems serving the people of Utah, with the objective of assuring development of an integrated, balanced statewide system. The Code's purpose is to protect the safety and general welfare of the people of the State and to preserve and improve all transportation facilities in Utah. Under Section 72-1-201, the Code sets forth the functions, powers, duties, rights, and responsibilities of the Department of Transportation to establish standards and procedures regarding technical details of administration of the state transportation systems.

The guidelines in this Standards Manual, the UDOT CADD Manual, and other CADD related manuals represent minimum requirements that must be met for the development of UDOT CADD projects. While the guidelines contained in this writing provide a basis for uniform CADD practice for UDOT projects, precise rules that would apply to all possible situations that may arise are impossible to give. Situations will exist where these standards will not apply. If variances from the UDOT CADD Manual or UDOT CADD Standards Manual are necessary for a project, they must be approved in writing by the UDOT Project Manager and documented in the Project Journal file as defined herein.

The CADD Standards Manual is published as a complete revision to the April 1997 Computer-Aided Drafting and Design Standards Manual.

Distribution

This document, along with the other CADD documents, is available in PDF format on the UDOT Engineering Technology Systems (ETS) Internet Website: http://www.dot.state.ut.us/ets/.

For questions or comments that are not addressed at the website, please contact the ETS office:

Utah Department of Transportation
Engineering Technology Systems
4501 South 2700 West
Salt Lake City, UT 84119
Telephone (801) 965-4662
FAX Number (801) 965-4604

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Procedure for Revisions and Updates

CADD Standards Manual holders are solicited for comments and suggestions for changes to this guideline. The ETS Website will provide a page to suggest changes or to log mistakes. Proposed changes to the CADD Standards Manual are also reviewed by the CADD Standard Committee, before the final change acceptance. Appropriate ETS staff will review each idea or suggestion received in a timely manner.

Major revisions are distributed in draft form to the Region Design Engineers for their review and comments, with the goal being to obtain a majority opinion before making a major revision.

After final revisions, the document will be published on the ETS website: http://www.dot.state.ut.us/ets/

Chapter 2 - UDOT CADD Software

General

The UDOT CADD software consists of three utilities: Cadd Setup Utility, Project Setup Utility, and Project Maintenance Utility. These utilities assist in the creation of the UDOT project Cadd Workspace, the project directory and file system, and project maintenance issues. These utilities are upgraded on an as-neecded basis. The updates and fixes are made available from the ETS website. Notification of new versions and updates are given on the ETS website and through training sessions as appropriate. UDOT has selected MicroStation and InRoads as its standard graphics and civil design packages. The programs that require these packages to function will be noted herein.

Distribution

Statewide distribution of major software upgrades for UDOT employees will be made to Region Technical Influencers for installation. ETS staff will be responsible for software distribution, installation or upgrades on the Region server and all Region workstations. Critical software updates may be distributed to Region Technical Influencers on an as needed basis for required plans production. Consultants can acquire the software from ETS directly or from the ETS website. Fixes and upgrades to the software will be made available from the ETS website.

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Support

If support is needed for the UDOT software, UDOT employees will first obtain help from their Region Technical Influencer. The UDOT CADD support structure and hierarchy is described in the UDOT CADD Manual. Consultants can contact the ETS office at (801) 965-4038.

Supported Products

The Core CADD Products used and supported by UDOT are:

MicroStation from Bentley Systems, Incorporated

InRoads SelectCad from Bentley Systems, Incorporated

Survey SelectCad from Bentley Systems, Incorporated

Storm & Sanitary SelectCad from Bentley Systems, Incorporated

IPLOT from Bentley Systems, Incorporated

The afore mentioned CADD products are commercial systems for which UDOT purchases a license for use. The Utah Department of Transportation makes no warranty, expressed or implied, as to the documentation; function or performance of these or other UDOT developed programs described within this document.

Trademarks

MicroStation, and MDL are registered trademarks of Bentley Systems, Inc.

Minimum system requirements

The UDOT CADD Software was developed and tested for the following standard workstation configuration:

- Approximately 200 megabytes of free hard disk space
- Windows NT 4.0 (service pack 5.0), Windows 98 &Windows 2000
- Microsoft Internet Explorer 5.0 or Netscape
- MicroStation J 7.1 (for some applications)

Note that other configurations may work, however the UDOT has not certified the software on any other configuration than that listed. Use and support of UDOT CADD Software on other configurations is the sole responsibility of the user.

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Applications

- UDOT CADD Software - (Contains the UDOT standard MicroStation cell libraries, font and custom linestyle resource files, seed files, and UDOT Cadd & Project Setup Utilities)

Translating Files From a Non-Microstation Format to Microstation Format

UDOT requires MicroStation format for the delivery of all graphics design files. Likewise, MicroStation shall be used for the production of Image files and Hardcopy plots according to Chapter 3 of the CADD Manual. The Consultant is solely responsible for any translation required to convert non-MicroStation graphics files to MicroStation design file format. All translated design files shall conform to the standards adopted by the Department for electronic plans in the UDOT CADD Manual and the specifications required in this document.

Chapter 3 - MicroStation Resource and Support Files

Fonts

MicroStation font resource files are binary files created from font cells, TrueType, Postscript, or AutoCAD shape fonts. MicroStation will read multiple font resource files according to the paths set by the MS_SYMBRSC configuration variable in the selected workspace. However, within MicroStation they are compiled into a list of all the fonts from all the resource files that were found. If one file contains a font with the same number assigned as another font resource file, the user will see the last one located. Also, UDOT has added to MicroStation's delivered fonts. For this reason UDOT has named their font resource file "udotfont.rsc". The Project Setup Utility will copy this file into the drive:\Project\Resources\Styles directory.

Standard practices for utilizing text include the following:

- Use text nodes in lieu of stacking text strings. Enter data field use is encouraged -- especially inside cells.
- Use lowercase lettering for existing information (initial letter capitalized); use uppercase letters for proposed information.
- MicroStation Font 3 - Engineering is the primary working font.
- Use Font 23 for italics and Font 43 for block letter.
- Fonts 60, 90, 91, 92, 94, 95, and 101, are speciality fonts used by Intergraph's InRoads family of programs. They include fonts of items such as arrow heads, shrubs and trees, traffic control signs, survey marks, etc. In many instances, you may prefer to use a cell rather than one of these fonts; however, these fonts are available for use.
- Place all text using a line style value of zero (lc=0). Any screened or patterned effect on text is handled via pen tables.

A font resource file can contain 256 fonts. The fonts contained within the udotfont.rsc file are described in Appendix A.

Text Size and Spacing

Standard text sizes and fonts have been defined to ensure uniformity and legibility on all CADD drawings. The correct text size is dependent on the plot scale. Since, the most important issue with text is that it should be legible, font and text size may vary as necessary.

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For text to be readable, it is necessary to place text a certain distance from any other text located near it. In many cases, text will be placed as a multi-line text string. For this text to be readable a line spacing attribute must also be set. Text line spacing should be, on average, three-fourths of the text height. As a minimum the line spacing will be one-half of the text height. The line spacing can be set in the text settings box or via the key-in: ls=.

The following tables of text sizes for plans at a given scale are to be use as a guideline for the minimum, desired, and maximum text size:

Standard Text Sizes

Metric Text Sizes for Typical Plotting Scales (for 11 x 17 plots)								
Metric Scales		S (Small Text)	M (Medium Text)	L (Large Text)	XL (Extra Large Text)	XXL (Extra - Extra Large Text)	Titles	Large Titles
Preferred Scale	Limited Use							
1:1		0.0015	0.00175	0.002	0.0025	0.00375	0.005	0.0075
	1:2	0.003	0.0035	0.004	0.005	0.0075	0.01	0.015
1:5		0.0075	0.00875	0.01	0.0125	0.01875	0.025	0.0375
1:10		0.015	0.0175	0.02	0.025	0.0375	0.05	0.075
1:20		0.03	0.035	0.04	0.05	0.075	0.1	0.15
	1:25	0.0375	0.04375	0.05	0.0625	0.09375	0.125	0.1875
1:50		0.075	0.0875	0.1	0.125	0.1875	0.25	0.375
1:100		0.15	0.175	0.2	0.25	0.375	0.5	0.75
1:200		0.3	0.35	0.4	0.5	0.75	1	1.5
	1:250	0.375	0.4375	0.5	0.625	0.9375	1.25	1.875
1:500		0.75	0.875	1	1.25	1.875	2.5	3.75
1:1000		1.5	1.75	2	2.5	3.75	5	7.5
1:2000		3	3.5	4	5	7.5	10	15

Placement of Text

The electronic file of a project are divided into two main categories: *design files and sheet files.* A design file contains all the information for a particular disipline along the entire length of the project. Sheet files are created by referencing several design files files and a border into a seed file and then clipping the boundary of the design files to fit the border.

Text used for callouts should be placed in the sheet file and not the design file. Other text such as text for alignment descriptions, contour labels, cross section text, profile text and other similar text can be placed in the corresponding design file.

For more information on the creation of sheet files see the Project Workflow for CADD Manual.

Sheet files should generally be place along the alignment. Exceptions to this rule may include the design crossing alignments such as an intersection. In a sheet file stationing should generally increase from the bottom to the top of the page or from the left to the right of the page. With this as the standard text should be placed readable from the bottom or right side of the page.

Line Styles

Line style (lc=) is part of the symbology of graphical elements in MicroStation. It defines lines as solid, continuous dashes, dots and dashes, and so on. Each element has its own line style (line code). An element can be set to the standard MicroStation line styles (numbered 0 - 7) or to a custom line style defined in a custom line style resource file. Custom line styles are user definable resource files for the display of different patterns, for example a tree line, fence line, guardrail, etc. When an element is drawn in MicroStation with a custom line style, the definition of the line style is not contained within the design file, only the line style name. The resource file from which it was selected must be packaged with the design file and it must be found by MicroStation's configuration in order to properly display the line. Therefore, users are strongly discouraged from creating their own custom line styles; instead using the UDOT supplied standard line style resources.

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UDOT uses line styles that represent various linear information types in graphic design files. The line styles are contained in a MicroStation resource file named MmmYY.rsc where Mmm is the month and YY is the two digit year the resource file was last updated. The Project Setup Utility will copy the most current line style resource file to the drive:\Project\Resources\Styles directory. This file is required for use on any UDOT project.

UDOT will modify this resource file periodically. It is, therefore, important to get the newest copy of the linesytle resource file at the beginning of each project. UDOT's line styles are shown in Appendix B.

Standard Metric Line Style Measurements for Plotting

style(1) = (0.4,1) units=MM, style = dot

style(2) = (2,1) units=MM, style = med dash

style(3) = (3.7,1.2) units=MM, style = long dash

style(4) = (2.5,1.2,0.7,1.2) units=MM, style = dot-dash

style(5) = (1,1) units=MM, style = short dash

style(6) = (2.1,0.71,0.71,0.71,0.71,0.71) units=MM, style = dash-dot-dot

style(7) = (3.1,0.7,1.4,0.7) units=MM, style = long dash - short dash

Standard English Line Style Measurements for Plotting

style(1) = (0.02,0.04) units=IN, style = dot

style(2) = (0.08,0.04) units=IN, style = med dash

style(3) = (0.15,0.05) units=IN, style = long dash

style(4) = (0.1,0.05,0.03,0.05) units=IN, style = dot-dash

style(5) = (0.04,0.04) units=IN, style = short dash

style(6) = (0.08,0.03,0.03,0.03,0.03,0.03) units=IN, style = dash-dot-dot

style(7) = (0.12,0.025,0.05,0.025) units=IN, style = long dash - short dash

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UDOT Custom Line Style Resource Files

For projects beginning with the release of the 2000 CADD Standards, UDOT has replaced all linear patterning on lines with custom line styles. As mentioned above, custom line styles are user definable in MicroStation. Caution must be exercised as the definition for the line style is maintained in a resource file and a design file only contains references to custom line style resource files. If a new (non-standard) custom line style is developed by a user, it must be place in a new resource file and the resource files must be delivered with the project. Users shall not modify the resource file(s) containing the UDOT standard custom line styles.

Line Weight

Line weight is an index in the range 0 to 31 that designates the weight or thickness of the line used to draw or plot a graphic element. Each element has its own line weight. The standard line thickness or width of a plotted graphic element in inches or millimeters for Laser, Electrostatic, or Ink Jet plotters shall be as follows:

Standard UDOT Line Weights

Line Weight	Line Thickness/Width	
	(Inches)	(mm)
0	0.002	0.05
1	0.006	0.15
2	0.014	0.35
3	0.025	0.625
4	0.037	0.95
5	0.059	1.50

Plotting

UDOT uses IPLOT, a product from Intergraph Corporation, to produce final plan sets. The resource files for IPLOT are located in the drive:\Projects\NNNNN_YY\SheetFiles\IPARM directory. The UDOT.pen file defines the line thickness/width of the plotted graphic element.

Plots can also be produced using a MicroStation plot configuration file (*.plt) to set and control the actual physical thickness of plotted information. A few plot configuration files have been created for standard printers and are located in the drive:\Projects\NNNNN_YY\SheetFiles\Plotdrv directory. These plot configuration files can be modified to fit the needs of the project. However, the plot must conform to the standard line weights listed in the table above.

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Modifications may need to be made to the displayable screen thicknesses for line weights so they will match the plotter drivers. These display settings are stored in the *.ucf file so they must be set on a user by user basis. The *.ucf file that is created by using the Project Setup Utility has been modified to match the plotter drivers.

Additional plotting information will be added to either this manual or the Project Work Flow for CADD manual as procedures and parameters are implemented. Currently, there are four plotter configuration files included in the CAD_Standards resources directory.

Color Table

A standard color table is necessary to provide visual consistency thus allowing users to easily identify elements in shared files and for consistency in color plotting. UDOT's standard color table, UDOT-Color.tbl, is the same as MicroStation's default 16-color table, color.tbl. A file named udotcolor.tbl can be found in the directory: *drive:\CAD_Standards\Resources\Styles.*

Cell Libraries

A standard UDOT cell libraries have been created for use with MicroStation. The cell libraries are found in the following directory:

drive:\CAD_Standards\Resources\Cell_Libraries

The table Table "Cell Library Files," on page6 lists the cell libraries that have been developed. Additional cells may be added on a project by project basis. The cells created for project use should be stored in a 3D cell library named PPPP_3dcell.cel where PPPP is the PIN number for the project. This file should be stored in the project directory under the \resources\cell_libraries sub-directories.

Cell Library Files

Cell Library	Description
Cartography.cel	mapping symbols
Hydraulics.cel	storm drainage details and symbols
Landscape.cel	landscape design symbols and details
Road.cel	road design details and symbols
ROW.cel	right-of-way symbols and details
Signals.cel	signal symbols and details
Signs.cel	roadway signs
Structures.cel	structural details and symbols
Survey.cel	details and symbols for existing features
Traffic.cel	traffic control symbols and details

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Settings Groups

The settings group files can help users set element attributes to correct symbology (line style, color, weight, text size, etc.). To use a settings group,

- Select Settings>Manage from the MicroStation application window
- Open a settings group if the correct one is not already loaded (File>Open in dialog box)
- Select the desired scale (for cells and text)
- Select the group, e.g. Surfaces or Text
- Select a component and MicroStation will set active element attributes such as weight, color, line style and the typical tool you will use such as Place SmartLine or Place Cell.

Level Files

The level names files can help you determine appropriate levels within the active design file for viewing and element placement. When working with reference files it is also helpful to know level numbers. The basic concept behind UDOT's level schemes is that different types of data are grouped in sets of 10 levels. For example, text is always placed on levels 50-60. So, when you want to turn off text levels in a reference file, you can turn off levels 50-60. The following charts can help you determine what items are on which level within the different design files.

The following sets of file types share level schemes:

- CARTOGRAPHY
- Road Design including: DESIGN, EXTOPO, UTILITIES, EXUTIL, GRADING, HYDRO
- PROFILE & XSECTION
- LANDSCAPE
- ROW & EXROW
- SIGNAL & EXSIGNAL
- SIGNING & TRAFCONTROL
- STRUCTURES
- SHEET - to be used for all sheet files, title sheet, plan, typical, summary, etc.

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Seed Files

MicroStation uses “seed” files to create all design files. These seed files are templates in which standard parameters are set according to what is needed to begin drafting for a specific type of work in accordance with UDOT standards. The seed file defines the working units for the file, global origin, view attributes, default color table, text settings, coordinate readout and several other important parameters. UDOT supplies seed files for both Metric and English - for plan view, cross section files, 3D files and seed files for certain specific applications. Seed files allow the user to begin work in a standard format and maintain uniformity. Two of the most important settings in the seed file are the working units and global origin. Working units are expressed as master units and fractional sub-units. The number of positional units per sub-unit is called the working resolution. The working resolution determines the precision to which elements are drawn and the size of the design plane. The design cannot exceed the working area. Because the size of the design plane is dependent on the precision as establish by the working units defined in a file, the working units must allow the required precision without overly limiting the coordinate range of the design plane. The format for the working units in MicroStation is defined as MU:SU:PU (master units, sub-units, positional units). The UDOT seed file working units are defined below:

Metric 3D Seed File:

Working Units:

Master Units = m

Sub-Units = 1000

Positional Units = 10 positional units.

Global Origin:X= -10000

Y= -10000

Z= 214748.3648

CADD Support Files

UDOT has developed two standard directory structures for CADD files; 1) the \CAD_Standards directory for UDOT standard support files, and 2) the \Projects directory which contains files specific to the project. The files and directory structure contained in the \CAD_Standards are used across all UDOT projects,. Therefore, access rights to the \CAD_Standards directory will be limited to read only for production personnel.

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The CADD support files are maintained on a CADD system server located in the Calvin Rampton Complex and mirrored on a CADD server in each region. These servers are mapped as the **M:** drive with the files in a directory named CAD_Standards.Consultants and remote offices can download a self-extracting zip file, caddstds.exe, which contains this information from UDOT's FTP server, which can be reached at ftp.dot.state.ut.us/ess.

The standards directory contains multiple base-line and seed files. A base-line file is a file that will be placed in a particular location on a design computer. Design applications such as MicroStation and InRoads may use these files across multiple projects. Usually, the base-line files begin with UDOT and newer versions are able to replace older versions. A seed file is region or project specific and resides on the main servers in the regional subdirectories

Note: some support files are unique to each project and some are universal to UDOT projects. The project specific files should be copied to the project directory when it is set up. Several of these files will need name changes once they are copied to the project directory. For example, any file whose name includes **NNNNN_YY** will be changed to the actual project identification number (PIN) followed by the STIP year for the project. Some of the files whose names begin with UDOT in the sup-

port directory should be renamed for more efficient use, e.g., udotcivil.ini, udotwysiwyg.ini, and udotsurvey.fwf should be renamed to civil.prf, wysiwyg.prf, and fldw2.fwf, respectively, so Intergraph's programs will automatically load the parameter files upon start-up.

Note: It is important that you read any README.TXT files you find in any of these directories before using the contents.

CADD SUPPORT FILE DIRECTORY STRUCTURE

drive:\CAD_Standards				
	\Doc			Electronic copies of standards manuals and help files.
	\General_Design			Standard application files.
		\Civil UDOTCIVIL.INI UDOT.TML UDOTWYSIWYG.INI		Files for use with InRoads SelectCAD, Storm and Sanitary SelectCAD, and Bridge SelectCAD.
		\Survey UDOTSURVEY.FWF FILELOC.INI		Files for use with Survey SelectCAD.
	\Resources			
		\Application		Programs for installing, maintaining, and removing UDOT projects, resources, and menus.
		\Cell_Libraries		Cell library files (.cel) to attach to design files.
		\Directory Templates		Templates for UDOT directories.
			\Bentley_Udot	Template directory structure for UDOT personnel using a network. Copied as a subfolder to a user specific folder.
			\Nnnnn_yy	Standard directory structure for UDOT projects. Must be copied to the *drive*:\Projects directory and renamed with appropriate PIN and Stip Year.
		\Iparm		Plotting Parameters.
		\Level_names		Level name files (.lvl) to attach to design files for referencing levels by name in addition to number.
		\Plotdrv		Plot driver files (.plt) to use for plotting directly from MicroStation.
		\Seed AR_SEED.DGN		Standard seed files for UDOT.
		\Setting_groups		Settings group files (.stg) to attach to design files for help in setting element attributes.
		\Standard_Drawing		Contains standard drawing sheets.

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CADD SUPPORT FILE DIRECTORY STRUCTURE

		\Styles	UDOT linestyles, fonts, and color table.

Note: the *Project Work Flow for CADD* manual will include information on project set-up and archival procedures. Until it is available, please call the ISS Engineering Support group at 801-965-4901 for help with project set-up.

Enhanced precision

With the implementation of MicroStation/J and the UDOT CADD software, UDOT is implementing the use of enhanced precision in the MicroStation design files made possible with the release of MicroStation SE and J. When enhanced precision is enabled, the numerical difference between the exact value of a coordinate position and the 32-bit integer UOR is attached to the element as an element linkage which is stored as part of the design file. Effectively, a 48-bit coordinate system is then available. This format provides more precision (greater number of decimal places) in large coordinate values, angles, etc. It also allows cells to be created at a one-to-one scale value, which was not possible previously for some of the very small items. With this capability, UDOT decided to base all items on a one-to-one scale factor. Using Enhanced precision does increase the design file size on disk. UDOT will implement the enhanced precision variable, MS_ENHANCEDPRECISION, as a project configuration variable defined in the *project*.pcf file. Thus, any file created within a project workspace will have enhanced precision turned on.

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Chapter 4 - Project Directory & File Names

The Standard Project Directory

Information required to produce a project from conceptual design through record drawings will be included in the directories outlined in this section. A standard format will allow for ease of use, a certain familiarity between departments and projects, and a consistent method of using reference file capabilities.

Each project shall have its own unique project directory. The project directory name shall follow this example: NNNN_YY where NNNN = UDOT Project Identification Number (PIN), and YY = the two-digit STIP year. Example: 456 is the PIN number and the anticipated year of construction (STIP year) is 2002. Thus, the project directory name would be 0456_02. The PIN number is available from the UDOT Project Manager. Under the project directory will be standard sub-directories for the different phases of a project, and directories for certain MicroStation support and resource files that are specific to the project. Each directory will contain a contents.txt file that will explain in more detail what files and data should be stored in that directory. A table in this chapter also lists the standard project directory structure with a description of each directory's purpose. If necessary, additional sub-directories can be added under the discipline specific sub-directories.

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The Civil_Data Directory

The Civil_Data directory will contain the files produced with the current version of UDOT's civil design software. Currently that software is InRoads SelectCad. These files include surface files (*.dtm), geometry files (*.alg), template files (*.tml), roadway definition files (*.rwl), and preference files (*.ini). More information on the CADD standards for civil design can be found in the Civil Design CADD Standards Manual. Other information that will be stored in this directory as they are implemented include sheet file images, quality control reports, and the ASCII Engineering Data output files.

File Sharing and Merging

Every project will utilize the standard directory structure regardless of the project requirements, even if the specific project does not include all of the disciplines listed in the standard structure. Data for each discipline will be maintained in its sub-directory, thus insuring the ability to merge data from different providers or disciplines at the time of delivery. **If a discipline requires information from another discipline, the needed file(s) should be referenced from the original directory and not copied.** For example, a Right-of-Way file will reference a Roadway design file, without copying it

into the Right-of-Way discipline directory. Each discipline must provide their electronic files in a standard format such that their customer (another discipline in the workflow) can use the data without the need to copy it and manipulate it.

Reference File Attachments

A reference file is a MicroStation design file or a raster image attached as a background file to an active design file, thus allowing several design groups to share the same information without the need to copy the file(s). MicroStation can attach a reference file by one of three different ways:

1) Name only – the path to the referenced file is resolved by the MicroStation configuration variable MS_RFDIR.
2) Full path –the reference file name and directory path is saved within the master file.
3) URL address – the file is attached in the form of a URL address using relative paths.

In order for a project to be delivered to UDOT in an electronic format that will allow future use of the files for printing purposes without modification to the files, the reference files must be attached in a way that will allow MicroStation to resolve the reference file attachment paths regardless of the drive or parent directory of the project. Option 1 (previous paragraph) is the preferred method for UDOT projects, since it allows the files to be moved from drive to drive without losing the reference file attachments. However, this option requires the MicroStation configuration variable, MS_RFDIR, be set for all UDOT projects and that all design files reside in the standard UDOTdirectory structure in order to be located. UDOT has set this variable in the project configuration file (*.pcf) file that is created with the Project Setup Utility.

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If for some reason, two files with the same name reside in two different directories of the project,MicroStation will attach the first matching filename it finds in the variable path. If in this case, if the file in a specific directory must be attached, it should be done using option 2, but in a manner that attaches the file relative (without the drive letter), as shown:

After browsing and selecting the design file from the reference file listdialog box, double click on the file name to open the attachment settings dialog box.

In the filename field, key-in the filename and the path in a URL format then click on the toggle for *Save Full Path.* This actually allows the file to be moved to a different drive while resolving the URL path.

The UDOT standard project directory structure and file naming conventions are based on the normal workflow of UDOT projects and the separation of workgroups. This allows the individual work-groups and disciplines to manage their own files, and eventually maintain their individual project indexes, the creation of Image Files for their sheets in the Plans, and ASCII output, without repercussions when the entire project is packaged together for delivery.

UDOT is attempting to provide tools that will enable a consultant or UDOT employee to be able to meet the data structure and delivery requirements for the Department. As mentioned, some tools are available from UDOT to accomplish this task. One such tool, the *Project Setup Utility* program can automatically create the project directory structure and eventually a project index. This program is available on the ETS Web site.

The Standard Project Directory Format

The standard directory structure (drive:\Projects\NNNN_YY) divided into its main categories is shown below along with a description of each directory's purpose.

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Subdirectory	Contents
\Survey_Data	All data existing data collected from field surveys, aerial or satellite surveys, GPS surveys, etc.
\Specifications	Standard specifications and special provisions related to the project
\Quantities	Spreadsheets, Engineers estimates, etc.
\Documentation	Subdirectories can be created as needed on a project by project basis; ie. Roadway_Design, Right_of_Way, Project_Management. etc.
\Civil_Data	Directory for all civil design files; (.dtm), (.alg), (.tml), (.rwl), (.rwk)
\Concept	All plans and files from concept and planning phase
\Existing	Existing document search, existing utilities drawings, existing right of way drawingsand information, existing signaling information, etc.
\Design	All design drawing files generated during the design phase, including right-of-way drawings generated during the design process
\Resources	Standard data files that need to be archived with the project, e.g., preference files, seed file, linestyles, plotter drivers
\Sheet_Files	All sheet design files that are produced for any design submittal

The following is an expanded view of UDOT's project directory structure.

PROJECT DIRECTORY STRUCTURE

drive:\Projects\NNNNN_YY		**Top Level Project Directory--NNNNN refers to PIN (Project Identification Number) and YY refers to STIP (State Transportation Improvement Program) year; drive will typically be N: on the UDOT network**
	\Civil_Data	Directory for all civil design files; (.dtm), (.alg), (.tml), (.rwl), (.rwk)
	\Concept	

PROJECT DIRECTORY STRUCTURE

	\Design			Directory structure contains all proposed designs
		\Hydraulics		
			\Analysis	
		\Landscape		
		\Right_of_Way		
		\Roadway_Design		
		\Structures		
			\Analysis	
		\Traffic		
		\Utilities		
	\Documentation			
	\Existing			
	\Quantities			
	\Resources			Files in these subdirectories can be modified to be project specific.
		\Applications		
		\Iparm		
		\Level_names		
		\Plotdrv		
		\Seed		Standard seed files for UDOT.
		\Setting_groups		
		\Standard_Drawing		Contains standard drawing sheets.
		\Styles		UDOT linestyles, fonts, and color table.
	\Sheet Files			
		\Landscape		
		\Right_of_Way		
		\Roadway_Design		
		\Signals_Lighting		
		\Structures		
	\Specifications			
	\Survey_Data			
		\Export		
		\Import		
		\Raw_Data		

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Note: the *Project Work Flow for CADD* manual will include information on project set-up and archival procedures. Until it is available, please call the ISS Engineering Support group at 801-965-4901 for help with project set-up.

Standard File Names

This section outlines the standard file names to be used for design files and sheet files. The distinction between the two files can be summarized as follows: 1) design files show the entire project in one file for each discipline while sheet files break the project into manageable lengths and show multiple disciplines, 2) design files contain actual design information while sheet files contain mostly references

to the design files, and 3) design files do not contain a border while sheet files do contain a border. Therefore, there are different standard naming conventions for files used as design files verses files used as sheet files.

Design information will be stored in separate files for different disciplines. A given set of design information will still be stored in one file only; reference files will be used to keep information up to date with design data from other groups. Breaking the design information into smaller pieces has several benefits:

1) Various departments and designers can work simultaneously instead of serially,
2) Any updates only have to be made once for all sheets to be updated, and
3) Users will not be slowed down by having to wait for large amounts of graphics to regenerate during panning and zooming operations.

Design files for a project will be grouped into three of the project subdirectories discussed in the previous chapter: \Design, \Existing, and \Sheet_Files. Each category will be broken into different types of information in several design files.

Design File Naming Convention UPDATED (12/11/00).

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Each of the file names will follow a consistent naming convention following this example:

PPPP_StdName_ANumeric_n.dgn.

where PPPP is the PIN number for the project, StdName is one of the standard names from Standard Design File Names for MicroStation Files by Major Directory or Standard Design File Names for MicroStation Files by Major Directory, ANumeric is an alpha-numeric description up to 8 character long, and "n" is the revision number of the drawing.

PPPP and StdName are required to be used. However, ANumeric and "n" are not required and are used at the discretion of the designer for ease of identifying files.

The ANumeric field could be used to identify different base files when a design is so large that more than one base file is necessary. As an example, I-15 has four design sections. Thus, the naming convention for this project would be similar to PPPP_design_Sect1.dgn, PPPP_design_Sect2.dgn, etc. The ANumeric field could also be used to identify miscellaneous data that is not coordinate specific such as details and typicals. As an example, PPPP_design_typicals and PPPP_design_details. Note: the StdName of "design" can be any of the standard names from Standard Design File Names for MicroStation Files by Major Directory or Standard Design File Names for MicroStation Files by Major Directory.

The revision number, “n”, is only used to keep track of different stages of the design or major changes to a design. A higher revision number means that the stage or change is more recent than one with a lower number. The base file used in the actual design of the project and in the sheet files must not have a revision number

Also included in the tables are settings group and level name files (*.stg and *.lvl extensions) that should be attached to the base file to assist in maintaining standard symbology and level structure. Note: If you choose not to use settings groups and need information regarding symbology for a particular file's graphics, please refer to Appendix ?? for expanded and detailed lists of symbologies and possible features to be included in each type of file.

Standard Design File Names for MicroStation Files by Major Directory

- Existing Directory

Table 4.1

File Name	SettingsGroup/ Level name files	Description
PIN_CARTOGRAPHY.DGN		Cartographic information that pertains to the design process
PIN_EXHYDRO		Existing hydraulic information -- may include information concerning stream and river locations, drainage areas, wetlands, etc.
PIN_EXROW.DGN		Existing right-of-way information -- may include information concerning property descriptions, right-of-way easement locations, etc.
PIN_EXSIGNAL.DGN		Existing traffic signalizations, electric loops, activators, etc.
PIN_EXTOPO.DGN		Existing topography -- may contain existing topographic contours at different intervals, spot shots, locations of various topographic features, etc.
PIN_EXUTIL.DGN		Existing utility information -- may contain information concerning existing utility easements, locations of existing utilities such as storm sewers, sanitary sewers, telephone and telegraph lines, natural gas lines, oil pipe lines, etc.

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- Design Directory

Table 4.2

File Name	SettingsGroup/ Level name files	Description
		This directory contains all base engineering files developed as a result of the design effort.
PIN_DESIGN.dgn	design.stg design.lvl	Proposed roadway design information

Table 4.2

File Name	SettingsGroup/ Level name files	Description
PIN_GRADING.dgn	grading.stg grading.lvl	Proposed grading information
PIN_PROFILE.dgn	profile.stg profile.lvl	Contains final profiles
PIN_XSECTION.dgn	xsection.stg xsection.lvl	Contains final cross sections
PIN_UTILITIES.dgn	utilities.stg utilities.lvl	Proposed utility plans -- corresponding profiles and cross sections will be placed in the profile and cross section files
PIN_HYDRO.dgn	hydro.stg hydro.lvl	Proposed hydraulic designs including storm sewers, detention and retention pond designs, basin maps, etc.
PIN_STRUCTURES.dgn	structures.stg structures.lvl	Proposed structural designs including bridges, culverts not covered by standard details, etc.
PIN_.ROW.dgn	row.stg row.lvl	Information necessary for final property purchase including legal descriptions, plot maps, etc.
PIN_TRAFCONTROL.dgn	trafcontrol.stg trafcontrol.lvl	Information necessary for temporary traffic control including lane striping, construction and detours.
PIN_LANDSCAPE.dgn	landscape.stg landscape.lvl	Landscaping design information including planting requirements, sprinkler systems, etc.
PIN_SIGNAL.dgn	signal.stg signal.lvl	Signaling information such as conduit locations and sizes
PIN_SIGNING.dgn	signing.stg signing.lvl	Signing and striping information

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Each of the standard files in the table above should be placed in the appropriate subdirectory according to discipline.

Note: A file named PIN_work.dgn can be used as a scratch or working file rather than a presentation file to be plotted. Its purpose is to provide a location for the designer to try alternative designs and develop ideas. Work.dgn files will be deleted when the project is archived. Thus, the PIN_work.dgn file should never be used as a reference file for the final sheet files.

Sheet File Naming Convention UPDATED **(12/11/00).**

Each of the file names will follow a consistent naming convention following this example:

PPPP_ID-#_ANumeric_n.dgn.

where PPPP is the PIN number, ID-# is a standard plan sheet code from standard drawing sheet 1A followed by the page number, ANumeric is an alpha-numeric description up to 8 character long, and "n" is the revision number of the drawing.

See Standard Sheet 1A, "Plan Sheet Codes and Descriptions" for a list of sheet ID codes that can be used.

PPPP and ID-# are required to be used. However, ANumeric and “n” are not required and are used at the discretion of the designer for ease of identifying files. As an example; a file named 0936_TC-1.dgn would be the file name for sheet 1 of the traffic control sheets.

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Chapter 5 - Project Journal Files

This chapter currently under development!

Project Journal Guidelines

A Project Journal (with a file Index included) will be produced and delivered in accordance with the UDOT CADD Manual. The purpose for this journal is to aid downstream customers of the CADD data so they may utilize existing CADD work in their processes. The format of the journal will be an electronic file that will be included with the project data on the prescribed media. The journal will contain the following information:

- A listing (Index) of the files delivered, including brief descriptions of each file in the directory structure and where the file is located.
- Documentation about the data (metadata) including major processes used, special CADD decisions made, exceptions to standards that were made, problems encountered and work around, or other important issues that arose during the course of the CADD work. For example, if a custom line style needed to be created, the justification, resource file, and files where that line style was used would be documented in the Journal. Other documentation such as the design software used, particular software settings, and other information that would help a downstream user of the data understand where and how the data was created should be documented.

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UDOT has not established a specific format for the Journal / Index. In the future, UDOT will supply tools to assist the CADD user with Journaling / Indexing activities. UDOT also allows 3rd party tools that will help produce the Journal, provided the resulting file(s) for the Journal can be viewed/printed with tools on-hand, such as those found in the Microsoft Office® Suite or an internet browser.

Important data that should also be contained in the Journal include:

- All information necessary for the regeneration or use of those files by subsequent customers of the CADD data
- Document the geometry database, controlling alignment and profile names and geometry input/output files, relevant survey information, cross sections and the methodology used to obtain the final geometric controls in the CADD product.

The project journal must be kept up to date as the CADD design work progresses and delivered with the project on the CD for archival purposes.

Example of CADD Project Index file:

CADD PROJECT INDEX FILE

(UDOTproject_index.htm)

2/24/00 4:22:45 PM

PROJECT INDEX FILE

This file contains information about the project 1234567 and the corresponding electronic files contained in the **project directory**. This file should be kept up to date and archived with the project's electronic files. When filling in the required information, please delete the instructions and examples in order to maintain a concise record.

PROJECT DESCRIPTION

Project ID Number:

Federal Aid Number: N/A

County: Salt Lake

Project Manager: Mr. Project Manager

Project Designer: Mrs. Project Designer

Project Directory: D:\e\projects\1234567

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SCOPE OF WORK:

The scope of work for project 1234567 goes here. Include as much detail as necessary to define the work done for the project.

PROJECT FILES

1234567

.....admin

.....eng_data

.....arch

.....eng_data

(etc…)

Discipline INDEX FILE

D:\my documents\UDOT2000\Cadindex.htm

2/16/2000

PROJECT INDEX FILE

Project Manager: Mr. Project Manager

Project Designer: Mrs. Project Designer

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Chapter 6 - CADD Standard Symbology

Guidelines for the Symbology Tables

Element symbology is the level, color, line style, line weight, text, font, and feature code of an element as assigned in MicroStation. Reference the "Element Symbology Tables" for the required standard symbology that is to be applied to each element. The purpose of assigning a specific symbology requirement to each element is to ensure the interpretation of an element, either by a person or by a computer program, is the same regardless of who or how many access the information later. Graphical CADD data is shared or accessed by many individuals and software, and standards ensure the ability to automate the process of generating quantities, cross sections, drainage structure sheets etc. There are occasions to deviate from standards, and examples include fonts and text sizes. These are somewhat flexible and should be set according to the need of the designer. See the suggested text size table for minimum, desired, and maximum size according to the plot scale of the drawing. However, if there is occasion to knowingly deviate from standards, then the justification for such a decision must be documented in the CADD Journal. Both the designer and reviewer of a design file must keep in mind the intent of the Element Symbology Tables -- that is, make the file useable by all parties, to automate computer processes, without overly complicating the drawing process. If an element is critical to the design process and workflow, it must be drawn according to the UDOT CADD symbology standards. If the element in question is only part of a graphical picture not accessed by other parties than the originator, then flexibility exists as long as the information is documented in the project CADD Journal. There are three criterion that determine if an element is considered critical:

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- Are the elements in a design file that is shared by other groups? Example: the topography file (topord01.dgn). It is shared by multiple groups and must be created in a format that allows it to be shared (referenced in MicroStation) by all affected groups without requiring them to copy the original and modify it to fit their needs.
- Are the elements used to generate Plan quantities? Example: the Roadway proposed design file (dsgnrd01.dgn). The proposed roadway design file is used to generate several quantities and to provide the boundaries of other quantities. Therefore all elements created in this type of file must be in accordance with the UDOT CADD symbology standards.

Are the elements in a design file used by subsequent customers for supplying data automatically to additional software packages? Example: The Roadway cross-section files (rdxsrd01.dgn, rdxsrd01.plg). These files are used by Construction to check earthwork quantities. The success of this process depends on strict adherence to the UDOT CADD symbology standards.

Precedence Hierarchy for interpreting the CADD Symbology Standards

The UDOT CADD Symbology Standards are stored in several formats. These include this document, the GEOPAK Design and Computation Manager database maintained by UDOT, the GEOPAK COGO features database, the UDOT Barmenus, UDOT MicroStation toolboxes and the GDM QC software rule files. Due to the inability to automatically exchange the UDOT CADD Symbology Standards between these different program formats and this document, it is necessary to manually enter the information. Because ofthis manual entry, a degree of error might be introduced between the different tables and programs. If the user of these resources encounters a conflict in standards, the UDOT CADD Office should immediately be notified so the situation can be rectified. When in doubt as to which standard to apply, an order of precedence for choosing between competing standards is required. The precedence table is shown below, going from highest precedence (top) to lowest (bottom):

Order of Precedence of the UDOT CADD Symbology Standards Tables and Databases:

- CADD Standards Manual
- Settings Group Files
- Axiom Rule files

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Existing Right of Way

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_exrown.dgn Level Name file: exrow.lvl Settings Group File: exrow.stg		
Level	**Level Name**	**Typical Features**
	Boundaries	
1	Political boundary lines	Government Land Office (GLO) lines, state, county reservation, and park boundaries
2	Political boundary points	section corners, township corners, etc.
3	Property lines	property, subdivision, lot, block lines, etc.
4	Property points	property corners
5	UDOT boundary	maintenance and district boundaries
	ROW	
10	Easement lines	
11	Access lines	
12	ROW lines	
15	ROW points	
	Text	
50	Political boundary text	
51	Political points text	
52	Property text	
53	UDOT boundary text	
54	Easement text	
55	Access line text	
56	ROW text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Existing Signal

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_exsignaln.dgn		
Level Name file: exsignal.lvl		Settings Group File: exsignal.stg
Level	**Level Name**	**Typical Features**
	Signals	
1	Boxes	controllers, junction boxes, service cabinets, etc.
2	Traffic signal lights	heads
3	Poles	signal poles, light poles, arms, extensions, luminaires, etc
	Circuits	
10	Circuit lines	conduitd, cables, etc.
11	Future use conduits	
12	Loops	loop detectors, amplifiers, etc.
13	Power source	
	Text	
50	Signals text	text for controllers, junction boxes, signal lights, poles, etc.
51	Circuit text	
52	Misc. text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Existing Topography

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_extopon.dgn
Level Name file: extopo.lvl Settings Group File: extopo.stg

Level	Level Name	Typical Features
	Survey	
1	Control lines	
2	Survey points	benchmarks, monuments, control points
	Roadway	
10	Curb & gutter	curb, gutter, curb & gutter, lip of gutter, flow line of gutter, top back of curb
11	Edge of road	paved, unpaved, edge of oil
12	Barriers	guard rail, attenuators, median barriers, etc.
13	Horizontal alignments	
14	Horizontal alignment points	PCs, PTs, event points
15	Driveways	driveways, parking lots
16	Sidewalks	sidewalks, misc. flat work, etc.
17	Signs	signs, reference posts, markers, etc.
18	Paint	striping, pavement markings
	Surfaces	
20	Index Contours	
21	Intermediate contours	
22	Breaklines	DTM breaklines, toe/top of fill/cut slope
23	Spot Elevations	natural ground shots, top of concrete, top of asphalt, etc.
24	Fences	
25	Paths/trails	
26	Ditches	top of ditch, ditch flow lines, etc.
27	Misc. surface features	swales, berms, pits, stockpiles
28	Vegetation	trees, shrubs, ground cover, etc.
29	Water features	rivers, lakes, canals, high water marks, wetlands, etc.
	Structures	
30	Hydraulic structures	storm sewer manholes, storm sewer lines, culverts, headwalls, catch basins, drop inlets, slope protectors, riprap, pipe flow lines
31	Road structures	bridges, abutments, piers
32	Walls	
33	Noise walls	
34	Buildings	building footprints
35	Misc. structures	pads, flag poles, bollards, tanks, etc.
36	Railroads	
	Text	
50	Survey text	
51	Alignment text	curve data, bearings, stationing, point text
52	Surface text	contour text, spot elevation text, etc.
53	Structures text	
55	Roadway text	
56	Grid marks & text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Existing Utility

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_exutil.dgn
Level Name file: exutil.lvl Settings Group File: exutil.stg

Level	Level Name	Typical Features
	Utilities	
40	Cable	lines and structures
41	Electrical	lines and structures
42	Gas	lines and structures
43	Telephone	lines and structures
44	Sanitary Sewer	lines, manholes, etc.
45	Water	lines, valves, pumps, etc.
46	Irrigation	pipes, mechanical equipment, etc.
47	Petroleum	lines and structures
	Text	
54	Utility text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Design

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_designn.dgn
Level Name file: design.lvl Settings Group File: design.stg

Level	Level Name	Typical Features
	Survey	
1	Control lines	
2	Survey points	benchmarks, monuments, control points
	Roadway	
10	Curb & gutter	curb, gutter, curb & gutter, lip of gutter, flow line of gutter, top back of curb
11	Edge of road	paved, unpaved, edge of oil
12	Barriers	guard rail, attenuators, median barriers, etc.
13	Horizontal alignments	
14	Horizontal alignment points	PCs, PTs, event points
15	Driveways	driveways, parking lots
16	Sidewalks	sidewalks, misc. flat work, etc.
17	Tick Marcks	Ticks for alignments
	Surfaces	
22	Breaklines	DTM breaklines, toe/top of fill/cut slope
24	Fences	
25	Paths/trails	
29	Water features	rivers, lakes, canals, high water marks, wetlands, etc.
	Structures	
31	Road structures	bridges, abutments, piers
32	Walls	
33	Noise walls	
34	Buildings	building footprints
35	Misc. structures	pads, flag poles, bollards, tanks, etc.
36	Railroads	
	Text	
50	Survey text	
51	Alignment text	curve data, bearings, stationing, point text
52	Surface text	contour text, spot elevation text, etc.
53	Structures text	
55	Roadway text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Grading

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_gradingn.dgn		
Level Name file: grading.lvl		Settings Group File: grading.stg
Level	**Level Name**	**Typical Features**
	Surfaces	
20	Index Contours	
21	Intermediate contours	
22	Breaklines	DTM breaklines, toe/top of fill/cut slope
23	Spot Elevations	natural ground shots, top of concrete, top of asphalt, etc.
26	Ditches	top of ditch, ditch flow lines, etc.
	Text	
52	Surface text	contour text, spot elevation text, etc.
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Hydraulics

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_hydron.dgn
Level Name file: hydro.lvl Settings Group File: hydro.stg

Level	Level Name	Typical Features
	Surfaces	
26	Ditches	top of ditch, ditch flow lines, etc.
28	Erosion control	
29	Water features	
	Structures	
30	Hydraulic structures	storm sewer manholes, , catch basins, drop inlets
31		storm sewer lines, pipe flow lines
32		culverts, headwalls
33		slope protectors, riprap, misc. hydraulic structures
	Text	
52	Surface text	contour text, spot elevation text, etc.
53	Structures text	
54	Utility text	
55	Erosion control text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Landscape

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_landscapen.dgn
Level Name file: landscape.lvl Settings Group File: landscape.stg

Level	Level Name	Typical Features
	Landscape	
1	Existing vegetation	trees, shrubs, turf
2	Trees	
3	Shrubs	
4	Ground covers	
5	Turf	sod, seed
6	Seeding	drill, broadcast
7	Mowstrip	concrete, timber, vinyl
8	Specialty paving	brick, exposed aggregate
9	Site amenities	picnic tables, pavilions, trash receptacles, ash trays, bollards, boulders, monument signs, flag poles, tree grates, drain grates, handrails
10	Planters	
11	Mulch	shredded bark, rock
12	Geotextiles	weed barrier fabric, filter fabric
13	Erosion control	blankets, straw bales, silt fence, check dams
14	Topsoil	contractor furnished, strip and stockpile, spread
	Irrigation	
30	Pipe	mainline, lateral
31	Sleeves	
32	Valves	control valves, gate valves, stop and waste, backflow preventers
33	Sprinklers	rotary, pop-up, impact, bubbler, emitter
34	Controller	
35	Meters	water meter
36	Pumps	
	Text	
50	Landscape text	
51	Irrigation text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Profile

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_profilen.dgn
Level Name file: profile.lvl Settings Group File: profile.stg

Level	Level Name	Typical Features
	Roadway	
10	Curb & gutter	curb, gutter, curb & gutter, lip of gutter, flow line of gutter, top back of curb
11	Edge of road	paved, unpaved, edge of oil
12	Barriers	guard rail, attenuators, median barriers, etc.
13	Vertical alignments	
14	Vertical alignment points	PVCs, PVTs, event points
	Surfaces	
20	Natural ground lines	
21	Proposed ground lines	
26	Ditches	top of ditch, ditch flow lines, etc.
	Structures	
30	Existing structures	storm sewer manholes, storm sewer lines, culverts, headwalls, catch basins, drop inlets, slope protectors, riprap, pipe flow lines, bridges, piers
31	Proposed structures	
36	Railroads	
	Utilities	
40	Cable	lines and structures
41	Electrical	lines and structures
42	Gas	lines and structures
43	Telephone	lines and structures
44	Sanitary sewer	lines and structures
45	Water	pipes, mechanical equipment, etc.lines, valves, pumps, etc.
46	Irrigation	pipes, mechanical equipment, etc.
47	Petroleum	lines and structures
	Text	
50	Survey text	
51	Alignment text	curve data, bearings, stationing, point text
52	Surface text	contour text, spot elevation text, etc.
53	Structures text	
54	Utility textq	
55	Roadway text	
56	Grid marks & text	
57	Axis lines & xsection text	
58	Misc. profile & xsection text	
59	Dimensions	including dimension text
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Right of Way

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_rown.dgn		
Level Name file: row.lvl		Settings Group File: row.stg
Level	**Level Name**	**Typical Features**
	Boundaries	
1	Political boundary lines	Government Land Office (GLO) lines, state, county reservation, and park boundaries
2	Political boundary points	section corners, township corners, etc.
3	Property lines	property, subdivision, lot, block lines, etc.
4	Property points	property corners
5	UDOT boundary	maintenance and district boundaries
	ROW	
10	Easement lines	utility easements, construction, work lines, etc.
11	Access lines	L/A, N/A lines
12	ROW lines	highway, frontage, railroad ROW lines
15	ROW points	
	Text	
50	Political boundary text	
51	Political points text	
52	Property text	
53	UDOT boundary text	
54	Easement text	
55	Access line text	
56	ROW text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Signal

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_signaln.dgn		
Level Name file: signal.lvl		Settings Group File: signal.stg
Level	**Level Name**	**Typical Features**
	Signals	
1	Boxes	controllers, junction boxes, service cabinets, etc.
2	Traffic signal lights	heads
3	Poles	signal poles, light poles, arms, extensions, luminaires, etc
	Circuits	
10	Circuit lines	conduitd, cables, etc.
11	Future use conduits	
12	Loops	loop detectors, amplifiers, etc.
13	Power source	
14	Temporary circuits	messenger cables, temp power sources, etc
	Text	
50	Signals text	text for controllers, junction boxes, signal lights, poles, etc.
51	Circuit text	
52	Misc. text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Signing

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_signingn.dgn
Level Name file: signing.lvl Settings Group File: signing.stg

Level	Level Name	Typical Features
	Signs	
1	Signs	street, overhead, advertising signs, etc.
	Pavement Markings	
10	Delineators	
11	Messages	Stop bar, crosswalks, school cross bars, RR crossing & X, turn arrows, etc.
12	Striping	
	Text	
50	Sign text	
51	Delineator text	
52	Message text	pavement marking messages text
53	Striping text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Structures

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_structuresn.dgn		
Level Name file: structures.lvl		Settings Group File: structures.stg
Level	**Level Name**	**Typical Features**
	Centerlines	
1	Beam centerlines	
2	Bent centerlines	
3	Grid centerlines	
4	Bearing centerlines	
	Roadway	
10	Curb & gutter	
11	Edge of road	
12	Barriers	
13	Horizontal alignments	
14	Horizontal alignment points	PCs, PTs, event points
15	Joints	
	Superstructures	
20	Beams	
21	Screed	framing, screed, beam location
22	Deck	
23	Approach slab	
	Minor Structures	
26	Culverts	barrel, wingwall, apron, headwall
27	Endsection	
	Substructures	
30	Foundation	
31	Piers	
32	Abutments & wingwalls	
33	Bents & columns	
36	Erosion control	
37	Slope protection	
	Details	
40	Detail graphics	
41	Rebar schedules	
	Text	
51	Alignment text	
52	Superstructure text	
53	Substructure text	
54	Minor structure text	
55	Roadway text	
56	Grid marks & text	
57	General notes	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Traffic Control

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_trafcontroln.dgn
Level Name file: trafcontrol.lvl Settings Group File: trafcontrol.stg

Level	Level Name	Typical Features
	Signs	
1	Temp signs	temporary signs
	Pavement Markings	
10	Temp pavement markings	temporary traffic striping
	Barriers	
20	Temp barriers	temporary barriers, attenuators, end sections
	TC Devices	
30	Warning devices	adv. warning panel, construction warning panels, regulatory devices, etc.
31	Channeling devices	cones, barrels, drums, vert. panels, barricades, etc.
32	Equipment	flagger stations, pilot cars, work vehicles
	Project Information	
40	Work area	cross hatching, etc.
41	Direction indicators	direction of traffic, direction of work vehicle, etc.
	Text	
50	Temp sign text	
51	Temp pavement markings text	
52	Temp barrier text	
53	TC devices text	
54	Project info text	work area, direction of traffic, etc.
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Utilities

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_exutilities.dgn
Level Name file: exutilities.lvl Settings Group File: exutilities.stg

Level	Level Name	Typical Features
	Utilities	
40	Cable	lines and structures
41	Electrical	lines and structures
42	Gas	lines and structures
43	Telephone	lines and structures
44	Sanitary Sewer	lines, manholes, etc.
45	Water	lines, valves, pumps, etc.
46	Irrigation	pipes, mechanical equipment, etc.
47	Petroleum	lines and structures
	Text	
54	Utility text	
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Cross Sections

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_xsectionn.dgn
Level Name file: xsection.lvl Settings Group File: xsection.stg

Level	Level Name	Typical Features
	Roadway	
10	Curb & gutter	curb, gutter, curb & gutter, lip of gutter, flow line of gutter, top back of curb
11	Edge of road	paved, unpaved, edge of oil
12	Barriers	guard rail, attenuators, median barriers, etc.
	Surfaces	
20	Natural ground lines	
21	Proposed ground lines	
22	Subgrade lines	
24	Fences	
26	Ditches	top of ditch, ditch flow lines, etc.
	Structures	
30	Existing structures	storm sewer manholes, storm sewer lines, culverts, headwalls, catch basins, drop inlets, slope protectors, riprap, pipe flow lines,bridges, abutments, piers
31	Proposed structures	
32	Walls	
33	Noise walls	
35	Misc. structures	
36	Railroads	
	Utilities	
40	Cable	lines and structures
41	Electrical	lines and structures
42	Gas	lines and structures
43	Telephone	lines and structures
44	Sanitary Sewer	lines, manholes, etc.
45	Water	lines, valves, pumps, etc.
46	Irrigation	pipes, mechanical equipment, etc.
47	Petroleum	lines and structures
	Text	
51	Alignment text	
52	Surface text	natural ground line text, spot elevation text
53	Structures text	
54	Utility text	
55	Roadway text	
56	Grid marks & text	
57	Axis lines & text	
58	Misc. profile & xsection text	
59	Dimensions	including dimension text
	Reserved	
60	unused 1	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Sheet Files

Associated dgn: Drive:\Projects\nnnn_yy\Existing\pin_sheet.dgn		
Level Name file: sheet.lvl		Settings Group File: sheet.stg
Level	**Level Name**	**Typical Features**
	Graphics	
1	Misc. sheet annotation	flags, north arrow, project limits
2	Detail graphics	
	Text	
50	Survey text	
51	Alignment text	curve data, bearings, stationing, point text
52	Surface text	contour text, spot elevation text, etc.
53	Structures text	
54	Utility text	
55	Roadway text	
56	Grid marks & text	including summary sheet column & row lines
57	General notes	
59	Dimensions	
60	Title block text	
	Reserved	
61	unused 2	
62	reserved 1	non-print level -- notes for designers, etc
63	reserved 2	non-print level

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Appendix A - Text Fonts

UDOT FONT LISTING	
FONT NAME	EXAMPLE
0 - STANDARD	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz Ø123456789
1 - WORKING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
2 - FANCY	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
3 - ENGINEERING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
7 - COMPRESSED	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
15 - IGES1001	ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
16 - IGES1002	ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
17 - IGES1003	ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
23 - ITALICS	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
26 - GREEK	ΑΒΧΔΕΘΓΗΙΦΚΛΜΝΟΠΞΡΣΤΥΦΩΧΨΖ αβχδεθγηιφκλμνοπξρστυφωχψζ ◇◇◇◇◇◇◇◇◇◇
30 - ISO_FONTLEFT	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
31 - ISO_FONTRIGHT	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *ABCDEFGHIJKLMNOPQRSTUVWXYZ* *0123456789*
32 - INTL_ENGINEERING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
33 - INTL_WORKING	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789

UDOT FONT LISTING

FONT NAME	EXAMPLE
41 - ARCHITECTURAL	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
42 - BLOCK_OUTLINE	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
43 - LOW_RES_FILLED	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
44 - LOW_RES_FILLED_BOLD	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
50 - UPPERCASE	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789
60 - FONT060	➢➢➢➢➢◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ➢➢➢➢➢◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
90 - font090	◇◇✻⊕◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇✻⊕◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
91 - font091	▶♀♀♀▯◐◇▭◇◐◇◇◇▭◇◇◇◇♀◇♀◇◇◇◇◇ ◇◇♀◇▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣▣ ◇◇◇◇▣◇◇◇◇◇◇◇
92 - font092	◇○△⊞✕◆⊛⊠⊕◇◆◇◇◉✕⊠◇+□⋀◇◇◇◇◇◇ ◇○△⊞✕◆⊛⊠⊕◇◆◇◇◉✕⊠◇+□⋀◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
94 - font094	ΔΔ⊙⊙⊙⊙⊙⊙⊙⊙⊙⊙Δ⊙⊙⊙℄H◇◇◇◇⊙◇◇◇ ΔΔ⊙⊙⊙⊙⊙⊙⊙⊙⊙⊙Δ⊙⊙⊙℄H◇◇◇◇⊙◇◇◇ ◇◇◇◇◇◇◇◇◇◇
95 - font095	◓◓○◒◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◓◓○◒◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇
100 - ANSI_SYMBOLS	ABCDEFGHIJKLMNOPQRSTUVWXYZ ∠—▱⌓○//⌭⌭I⌖⌒⊥Ⓜ∅○Ⓟ⌭⌭◎ⓈⓁ⌴∨↧□Y◺ 0123456789
101 - FEATURE_CONTROL_SYMBOLS	ABCDEFGHIJKLMNOPQRSTUVWXYZ ∠—▱⌓○//⌭⌭I⌖⌒⊥Ⓜ∅○Ⓟ⌭⌭◎ⓈⓁ⌴∨↧□YZ 0123456789
102 - SYMB_FAST	➢ ➢▷➢▶▷➢⌇∅⌒➢⌇•◇◇◇◇◇◇◇◇◇◇◇◇ ➢ ➢▷➢▶▷➢⌇∅⌒➢⌇•◇◇◇◇◇◇◇◇◇◇◇◇ ◇◇◇◇◇◇◇◇◇◇

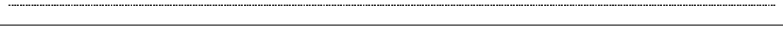
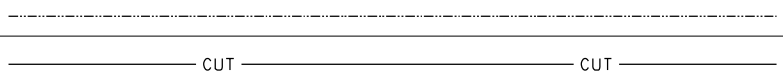
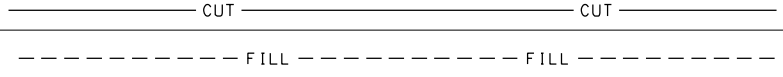
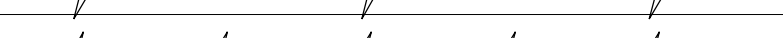
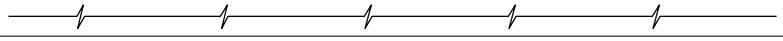
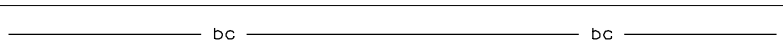
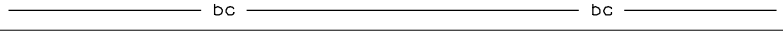
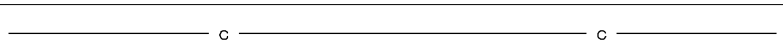
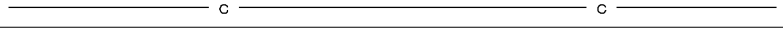
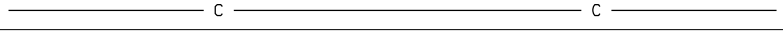
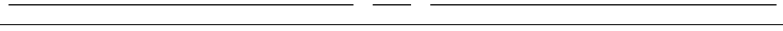
UDOT FONT LISTING

FONT NAME	EXAMPLE
105 - INTL_ISO	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
106 - INTL_ISO_EQUAL	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
107 - INTL_ISO_ITALIC	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
108 - INTL_ISO_ITALIC_EQUAL	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
127 - CHAR_FAST_FONT	ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJKLMNOPQRSTUVWXYZ Ø123456789
128 - Times New Roman Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
151 - arial	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
158 - Times New Roman Bold Ital	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***
164 - Arial Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
171 - Courier Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
175 - Courier	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
177 - Arial Block	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
190 - Times New Roman	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
196 - Courier Bold Italic	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***

UDOT FONT LISTING

FONT NAME	EXAMPLE
203 - Times New Roman Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
211 - Courier Italic	*ABCDEFGHIJKLMNOPQRSTUVWXYZ* *abcdefghijklmnopqrstuvwxyz* *0123456789*
217 - Arial Bold	**ABCDEFGHIJKLMNOPQRSTUVWXYZ** **abcdefghijklmnopqrstuvwxyz** **0123456789**
247 - Arial Bold Italic	***ABCDEFGHIJKLMNOPQRSTUVWXYZ*** ***abcdefghijklmnopqrstuvwxyz*** ***0123456789***

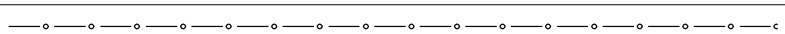
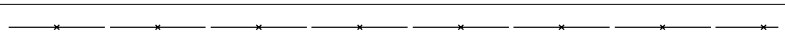
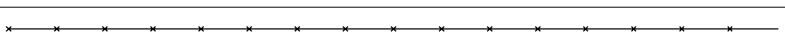
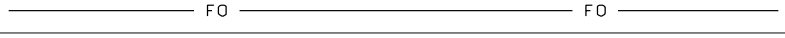
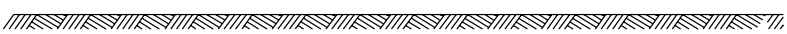
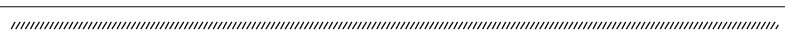
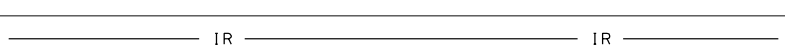
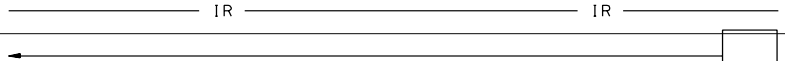
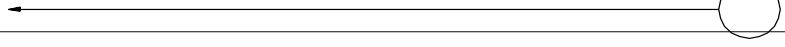
Appendix B - Custom Linestyles

UDOT LINE STYLES	
EXAMPLE	LINE STYLE NAME
	(Border)
	(Center)
	(Dashdot)
	(Dashed)
	(Divide)
	(Dot)
	(Hidden)
	(Phantom)
	Breakline Cut
	Breakline Fill
	Breakline Structure 1
	Breakline Structure 2
	Breakline Structure 3
	Cable Buried Exist
	Cable Buried Prop
	Cable OH Exist
	Cable OH Prop
	Center 1
	Center 1 STR
	Center 2
	Center 2 STR
	Center 3
	Center 3 STR
	Center 4
	Center 4 STR
	Channel Lined
	Concrete 1 STR
	Concrete 2 STR

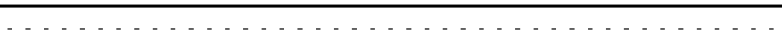
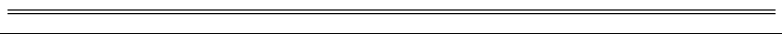
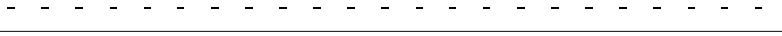
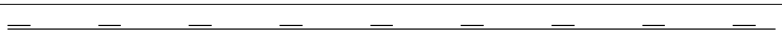
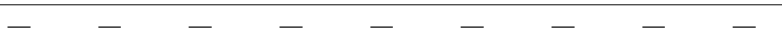
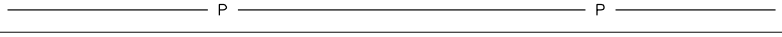
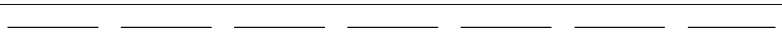
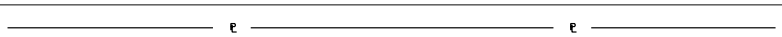
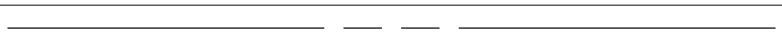
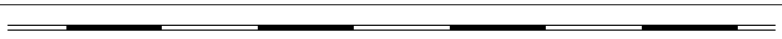
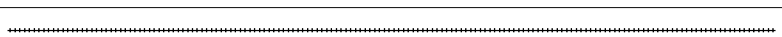
UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Concrete Boundary Struct
	Conduit Steel Exist
	Conduit Steel Prop
	Dash 1
	Dash 2
	Dash 3
	Dash 4
	Dash Double
	Depression
	Depression Dash
	Detector Circuit
	Dim Continuation
	Dim Inside Large
	Dim Inside Small
	Dim Outside Large
	Dim Outside Small
	Ditch Irrigation
	Ditch Unlined
	Ditch Waste
	Dot 1
	Dot 2
	Dot 3
	Double Dash 1 STR
	Double Dash 2 STR
	Double Line
	Double Line Dashed
	Drain Tile
	Elec Buried Exist
	Elec Buried Prop
	Elec OH Exist

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Elec OH Prop
	Existing Pipe
	Fence
	Fence Link Exist
	Fence Link Prop
	Fence Link Structure
	Fence Wire Exist
	Fence Wire Prop
	Fence Wood Exist
	Fence Wood Prop
	Fenceline
	Fiber Optic Exist
	Fiber Optic Prop
	Flow Direction
	Gas Line Exist
	Gas Line Prop
	Ground Exist
	Guard Rail Exist
	Guard Rail Prop
	Hash 1
	Hash 2
	Hash Shade 1
	Hash Shade 2
	Irrigation Ag Exist
	Irrigation Ag Prop
	Leader Box Left
	Leader Box Right
	Leader Bubble
	Multiple Arrow
	Multiple Arrow Dash

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Paint: Dotted
	Paint: Double Solid
	Paint: Lane Drop
	Paint: Perm Left
	Paint: Perm Right
	Paint: Skip
	Paint: Solid
	Paint: Solid 200
	Paint: Solid 300
	Paint: Temp Skip
	Paint: Xwalk
	Paint: Xwalk Ang
	Petro Prod Exist
	Petro Prod Prop
	Property Line
	R/W 40 Acre Line
	R/W Boundary1
	R/W Boundary2
	R/W Boundary3
	R/W Fence Exist1
	R/W Fence Exist2
	R/W LA/NA
	R/W Lot Line
	R/W PL
	R/W Property Line
	R/W QTR Sec Line
	R/W Railroad1
	R/W Railroad2
	Railroad 1
	Railroad 2

UDOT LINE STYLES

EXAMPLE	LINE STYLE NAME
	Railroad 3
	Riprap Large Below
	Riprap Large Centered
	Riprap Small Below
	Riprap Small Centered
	Road Comp Surface
	Road Graded Drained
	Road Gravel
	Road Gravel Graded
ss ss	San Sewer Exist
SS SS	San Sewer Prop
	Signal Circuit
sd sd	Storm Drain Exist
SD SD	Storm Drain Prop
	Stream Intermittent
bt bt	Tel Buried Exist
BT BT	Tel Buried Prop
t t	Tel OH Exist
T T	Tel OH Prop
	Tree Line
	Tree Line Dashed
	Wall Block Exist
	Wall Masonry
	Water Edge
w w	Water Line Exist
W W	Water Line Prop

DRAFT